Resource Assessment

Overview

The resource assessment takes an interdisciplinary team (ID) approach with team members possessing skills in forestry, forest hydrology, fisheries, forest soils science, geology, and geomorphology. The primary objectives of the scientific team are: (1) to develop an understanding of the past and present factors influencing watershed condition and a comprehensive view of the cumulative effects of practices, and overall vulnerabilities of the watershed as a whole, and (2) to locate any areas sensitive to erosion, hydrologic change and riparian functions, establishing the level of sensitivity based on the risk to public resources, for which prescriptions must be developed. The inventories and subsequent interpretations provide a basis for area-specific problem statements and rule calls, linking forest practices, watershed processes, and resource effects. The expectation is that the team can construct a complete picture of a watershed and how it works at a scale appropriate for guiding land use decision-making.

To accomplish this, the various TFW cooperators envisioned a watershed resource assessment method that meets the following specifications:

Comprehensive: a framework appropriate for the assessment of a variety of watershed processes and potentially affected public resources, including fish, water quality, water supply, and public capital improvement. The framework should be compatible with wildlife assessment needs, even though a wildlife component is initially excluded.

Area-Specific Focus of Analysis: methods should confront problems of scale, resolution, and natural variability of landscapes. The method should be designed for more detailed and intensive focus (at higher resolution) when so dictated by processes under evaluation.

Scientific Grounding: evaluations should be based on the best science available.

Repeatability: methods should be specified to ensure that the same conclusions and results could be reached by independent reviewers.

Explicit Treatment of Uncertainty: key assumptions should be displayed; potential for error should be clearly defined.

Accountability: all assessments and determinations should be supported by a written record that provides a basis for decisions and interpretations.

Delivering the expected products while satisfying these criteria poses a challenge for design of the resource assessment method since none of the watershed assessment or cumulative effects methods currently available satisfy all of them. To meet the specifications as closely as possible, the resource assessment procedure included in this manual includes a mixture of analytical and qualitative assessments performed by the individual scientific disciplines and the team as a whole.

Basic Features and Design of Resource Assessment

To comprehensively address the sensitivity of multiple watershed processes to forest practices, and to determine the current condition and vulnerability of a variety of public resources, a two-stage process was developed.

In the first stage, the interdisciplinary team members develop data, observations, and interpretations for each watershed and public resource component. This stage of resource assessment is termed the "Inventory Stage" (see Figure 2). Assessing multiple watershed processes is accommodated by analysts first working relatively independently from one another, with each focusing on a particular aspect of watershed function and identifying conditions at whatever scale is appropriate for that process. Thus, during the inventory stage each analyst takes an area-specific focus using a "top-down" approach. Data is gathered and interpreted for individual watershed processes and resources with the intent of identifying and mapping specific areas of sensitivity or resource concern (these areas can include the entire watershed).

Most of the time spent in resource assessment will be taken up accomplishing the various inventories and most of the data that will be collected for the watershed is done during this stage. The inventory stage provides the preliminary identification of sensitive areas, contributing forest practices, and resource vulnerabilities. Assessment products and interpretations completed during the inventory stage are passed along to later phases for integration at the watershed scale.

Once the individual watershed processes have been evaluated, the collective team considers the individual locations and potential impacts in a broader spatial and temporal context in the second stage of resource assessment -- "Synthesis". During this stage, the team considers a "bottom up" perspective of the watershed. They view the potential for changes in watershed processes to affect specific stream segments or resource locations, thus allowing the consideration of cumulative watershed effects on specific public re-

sources. Based on the information gathered in inventory, the assessment team confirms the existence of resource sensitivities by linking the identified potential impacts (causes) to the identified or existing or potential resource vulnerabilities (effects).

Although the resource assessment is presented as a staged process, the boundary between phases will not necessarily be sharp. Although most interdisciplinary dialogue occurs during the synthesis or second stage, it should be recognized that inter-team dialogue may be very helpful during the inventory stage as well. In addition, even though most of the data used by the team is generated during the inventory stage, the group may find it necessary to gather additional data during the synthesis stage to resolve uncertainties that arise during watershed hypothesis building.

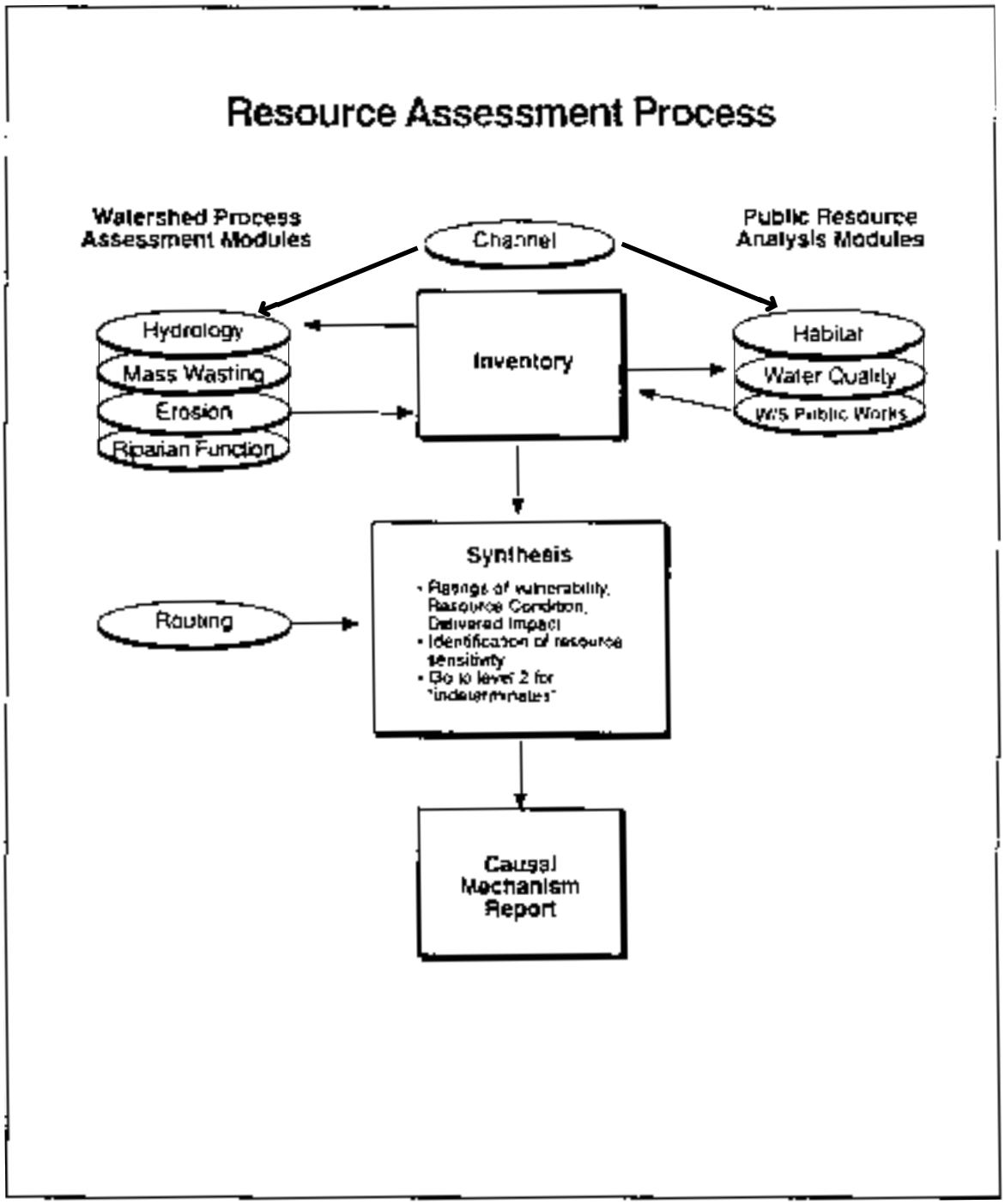


Figure 2. Diagram of the Principle Elements of Resource Assessment

Scientific Structure

The status of scientific knowledge today is such that we cannot say we know all of the answers leading to full interpretation of all of the watershed processes to be included in watershed analysis. We do feel reasonably certain, however, that science has identified the appropriate questions to ask, so that if they were answered with data from a watershed, its status would be reasonably well understood. Therefore, all of the methods for individual processes and the watershed as a whole that are described in this manual have a question-based framework, where critical questions define what is to be addressed by the assessment team. The questions are framed at an overview conceptual level and establish important points of understanding that should be established if sound interpretations are to be made. These questions, rather than the methods, are probably the best representation of the scientific understanding of watershed processes that CMER believes would yield correct watershed interpretations.

The methods provided in the manual reflect a CMER consensus on the best techniques currently available that are recommended for answering the critical questions given our current knowledge, as well as personnel and time allocations. It is assumed that as better techniques are developed for answering each of the critical questions, they can be replaced in future versions of the manual. Adhering to the critical questions as a framework allows such improvements to be made without fundamentally altering the intent and structure of the watershed assessment.

Methods that address the critical questions suffer from the immaturity of some of the scientific disciplines and lack of experience with analyzing processes on the watershed scale. The mechanisms determining potential for forest practices to change the rate of geomorphic inputs are relatively well understood and the module methods for mass wasting, surface erosion, hydrology and riparian function are semi-quantitative. Methods for correlating the extent of response of channels and biologic communities to changes in geomorphic inputs are not as well developed, even though mechanisms for response are reasonably well understood. Therefore, methods for determining resource vulnerabilities (fish habitat, channels, public works) are necessarily more qualitative. Furthermore, the systematic linkage of multiple processes, practices, and resources at the watershed scale in a reliable process has no precedent in the scientific literature. Because of these deficiencies, individual methods and models must be linked in less comprehensive, less quantitative fashion. However, it appears that qualitative interpretations supported by observations are likely to be informative at the scale appropriate for land use decision-making in the watershed.

Although the methods are designed to be as quantitative as possible, nearly all of the methods included in the manual rely heavily on the ability of the

scientists and managers to use a scientific process of hypothesis development tested by observation, rather than a "cookbook recipe" approach. The critical questions guide the line of inquiry, no matter what the qualifications of the analyst or level of assessment. The standard methods described in detail in Appendices A-I direct the analyst to develop a minimum set of data to address the critical questions. The modules are designed to provide as much flexibility as possible to the resource assessment team, by allowing them to suggest alternative methods and to spend more time addressing particular critical questions as appropriate in a particular watershed.

Despite the flexibility allowed in the assessments, a reasonable degree of repeatability of a scientific interpretation and products is ensured by (1) the critical question framework, (2) the description of techniques provided in each module, (3) the explicit requirements of certain analysis products, and (4) the retention of records, observations and methods used for analysis of variance from manual methods.

Explicit Treatment of Uncertainty

The reliability of the resource assessments is dependent on the quality of the specified procedures, the skills of the assessment team members, and the time and resources provided for the assessment. It is expected that the assessment methods provide problem determinations with reasonable confidence, although it is recognized that errors can be made. Reliability can be expressed in terms of the potential or likelihood for correct and incorrect calls. Two types of errors (or incorrect calls) are possible:

1. False positives - concluding that a problem exists or condition is present, or a cause-effect linkage exists when it really doesn't.

2. False negatives - concluding that a problem doesn't exist when it does.

Although greater reliability is ordinarily attained through more intensive analysis providing greater resolution, the widespread application of such intense procedures is not practical given personnel and financial limitations (Figure 3). The proposed methodologies attempt to strike a balance between certainty requirements and the resources available to achieve them. Where considerable uncertainty exists, the methods are designed to err on the side of a decision conservative for the public resource.

Watershed analysis confronts this tradeoff by allowing for two different levels of analysis.

Level 1 - about three weeks for the assessment by a team of five or six; emphasis on remote analysis with limited field work. Cooperators have indicated that Level 1 should be within the capability of current TFW ID teams

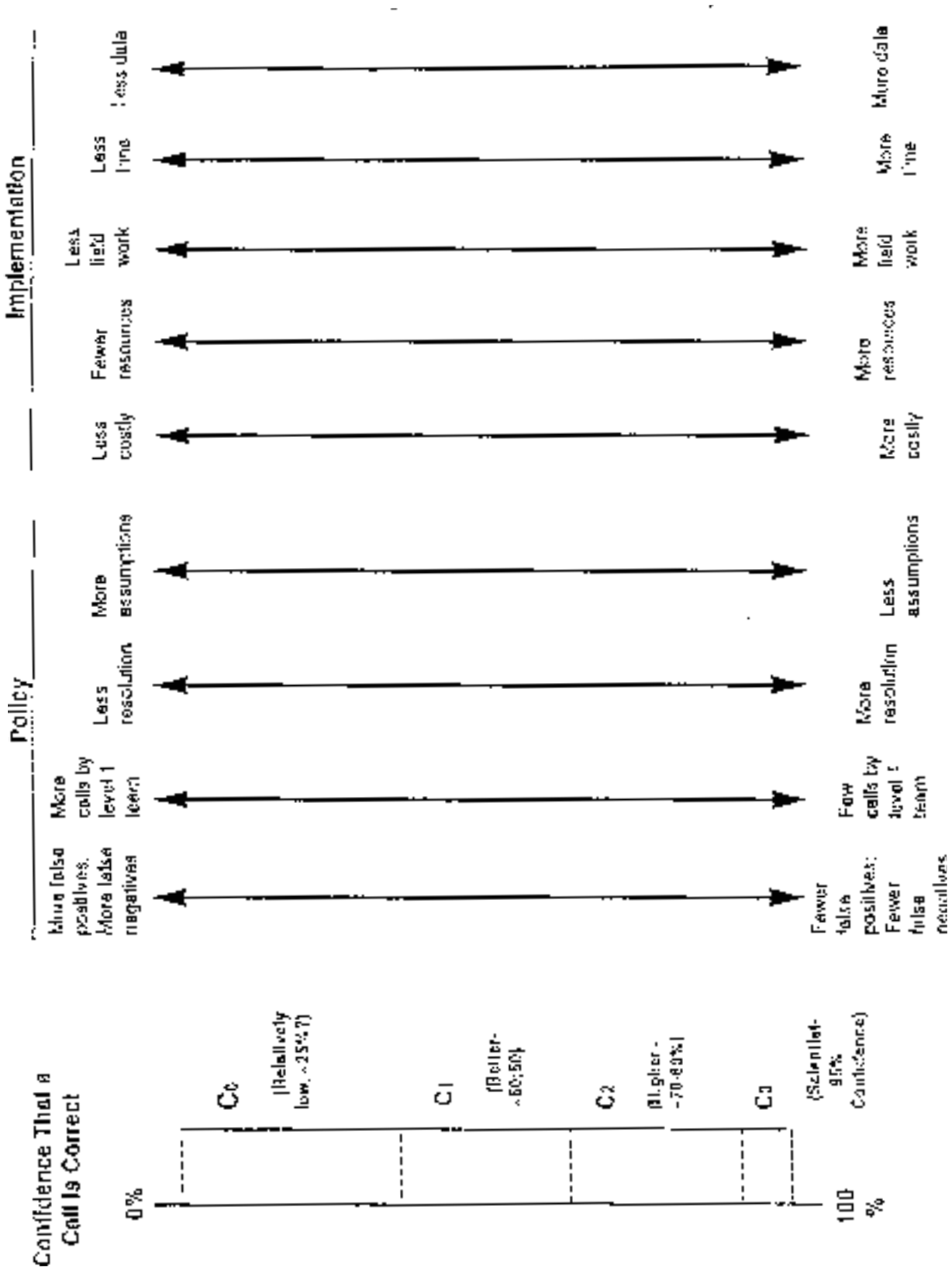
whose skills would be augmented with additional training. A typical Level 1 team would possess college degree-level expertise.

Level 2 - three to eight weeks, with greater emphasis on field work; analysis designed to resolve Level 1 indeterminate calls and offer greater resolution and certainty. A Level 2 team would possess higher skill levels and greater experience in each of the individual disciplines. A typical Level 2 team would possess Bachelor's and probably advanced degrees in relevant disciplines.

In developing and testing hypotheses, the Level 1 team will attempt to reduce the potential for either type of error. The assessment teams are expected to attempt to resolve uncertainties as much as possible. In cases where significant residual potential exists, the team will conclude that a situation is "indeterminate," warranting clarification through a Level 2 analysis. The specific likelihood threshold for making a call that a situation is "indeterminate" has not been developed, although guidance is provided in the manual for when indeterminate calls may be appropriate.

To date, the reliability of the procedures provided in the manual have not been determined. It is the hope that the CMER research program will provide improved scientific knowledge so that gaps can be bridged, eventually leading to more balanced but simultaneously reliable decisions.

Figure 3. Tradeoffs Among Cost, Resolution and Certainty



Accountability

Accountability is accomplished by specification of a number of analysis products. These include maps, worksheets recording data and key observations leading to interpretations, and brief narratives summarizing findings. It is recognized that the time limitations imposed by the rule prevent elaborate report writing. The required products allow the resource assessment team to convey key findings systematically but efficiently.

Resource Inventory

Overview

With basic background information assembled, the team begins the assessments, applying methods identified in the resource assessment modules (Appendices A-H). Inventory calls for assessing the watershed processes (mass wasting, surface erosion, hydrology and riparian function) that generate wood, water, energy, and sediment and the condition of resource characteristics shaped by them (stream channels, fish habitat, water quality, and public works). The scientific investigation includes assessments of current and potential watershed and resource conditions. Existing and potential sensitive areas and their relationship to resource vulnerabilities are identified. Each of the process assessments results in maps, data sheets and narratives. These are used during synthesis to support the ratings of resource vulnerability, resource condition and delivered potential impact and form the basis for causal mechanism reports forwarded to the prescription team.

Each module is organized around a series of primary questions designed to identify the important scientific issues relevant to the process or resource condition under assessment. Generally, it will be possible to answer the module questions without a great deal of interdisciplinary dialogue. Answers are based upon decision criteria specified in each of the modules, resulting in maps, forms, and worksheets that provide an accounting trail and support the integration that occurs under synthesis. Although the inventory assessments will generally be conducted independently, team members may choose to interact to define areas and issues of mutual concern.

Inventory assessments require a mix of office and field work guided by the methods specified in the individual assessment modules. The specific steps to be followed in each of the assessments to answer the critical questions are defined within the modules. The methods provided in the modules represent the standard methods for watershed analysis. That is, all teams regardless of specified level produce the standard set of products and address each critical question. The expectations of the teams differ in the degree of reso-

lution each achieves in answering the questions. Level 1 assessments are likely to have less field work and less quantitative products and more indeterminate calls. Level 2 assessments are likely to have greater resolution, more quantitative supporting data, and additional products that they generate to address uncertainties.

The timing of the resource assessment can be important to gathering good data and could affect the certainty of the results. For example, especially in the higher elevations, much of the landscape is covered by snow during the winter months, possibly hiding some of the information needed for thoroughly analyzing the resources. However, it is not expected that all assessments should be done in the summer months.

Critical questions, assessment methods and interpretations differ between watershed processes (causes) and public resources (effects).

Watershed Processes

Watershed Process critical questions are designed to identify sources of sediment, water, and wood; the conditions under which processes are activated; reference conditions; and delivery to streams. Although the questions in each module are specific to the watershed process being evaluated, the questions generally address:

- Locations and descriptions of hazard areas for each process based on mapped landscape potential.
- Management activities associated with the process (e.g., road building).
- Delivery of materials to the stream system.
- Geomorphic inputs potentially affected by the process (e.g., coarse or fine sediment, wood, etc.).
- Baseline or reference conditions for each process that provide a basis for potential impact evaluation. (Note that this is not consistent among the modules.)

Public Resources

Resource questions establish existing conditions, reference conditions, and sensitivities of segments to potential changes in inputs of wood, water, heat energy and sediment. Public Resource assessments are guided by questions that address the following:

- Channel locations susceptible to changes in inputs of wood, water, energy, and sediment (response segments);

- Current channel conditions and sensitivities (e.g., transport capacity);
- Resource potential of segments (fish habitat module only);
- Current resource conditions; and
- Sensitivity (or responsiveness) of resource conditions to changes in inputs of wood, water, energy and sediment.

Public resource assessment teams gather facts and data to characterize resource characteristics sensitivities. Maps are developed locating resources that may be susceptible to changes in flows of fine and coarse sediment, wood, water, and energy (response segment identification). The team then evaluates current conditions based on defined indicators. For fish habitat, these indicators include spawning gravel condition and pool:riffle ratio. Resource analyses also relate current conditions to segment potential which takes into account physical characteristics of segments (e.g., gradient and confinement). Each of the public resource assessments results in maps and data sheets that are used by the team in synthesis and support the rule matrix calls.

Procedure

Detailed methods for conducting the resource assessments are provided in modular form in Appendices A-I of this manual.

1. Mass Wasting Module *(Appendix A)*
   - shallow rapid landslides
   - undifferentiated debris torrents
   - deep-seated mass movements
2. Surface Erosion Module *(Appendix B)*
   - surface erosion from roads
   - surface erosion from hillslopes
3. Hydrology Module *(Appendix C)*
   - change in channel forming flows
4. Riparian Function Module *(Appendix D)*
   - riparian wood recruitment
   - riparian shade provisions

5. Stream Channel Module *(Appendix E)*
   - Effects of regimes of wood, water, coarse sediment, and fine sediment

6. Fish Habitat Module *(Appendix F)*

7. Water Quality Module *(Appendix G)*

8. Water Supplies/Public Works Module *(Appendix H)*

Module Project Management

This section describes the steps in an inventory module of the resource assessment from a project management perspective. It is directed primarily to the module leader who is working with others to complete the module, especially in the situation where the team may consist of observers or guest analysts from different organizations. We encourage all module participants to read this section, however, since it may help them to understand project tasks and timelines and clarify expectations of the module leader regarding their involvement. Careful attention to project management considerations will greatly facilitate review and consensus on module products in later stages. Module products and team support will be superior when the team is able to fully and effectively participate in their development.

The module leader must be technically qualified to complete the module assessment according to the criteria listed in the manual and by the DNR official process of skills review and training. Ensuring that the products are complete and as technically correct as possible is the primary responsibility of the module leader. S/he is also the primary representative of the team in communicating analysis results and interacting at later stages of assessment and prescriptions in watershed analysis. The module leader may call upon team members to assist in those efforts.

Managing the module team through the assessment process is also an important function of the module leader, especially where there are observers or qualified analysts participating on a full or part-time basis. The module leader must facilitate review of the products within the team and help to resolve concerns as the assessment proceeds. It is important that team members understand how and when intermediate and final work products are developed and when critical review points are reached so that they can effectively participate in the assessment. The module leader will need to be clear about the team's certainty and level of agreement on the key findings of the assessment as they carry their results forward. Specific tasks and milestones are provided in a Module Project Task checklist provided in each module. We suggest that the module leader review the module methods and expected products with the team at the outset of the assessment, and that the team complete the schedule together so that expectations are clear.

Startup

The module leader's tasks begin during preparatory steps preceding watershed analysis. S/he should be sure that information needs such as aerial photographs and maps are accessible as early as possible. At the start-up meeting, the module leader should identify the interested participants, if s/he has not already done so. S/he will review the module methods with the team, explain when and what critical reviews will occur and schedule the sequence of project tasks.

Resource Assessment

The module leader may enlist team members to help conduct office and field work, or may involve team members primarily in review of the products as they are developed. Regardless of the approach the team chooses, scheduling will be critical to timely delivery of module products within the short time frames that the team must work.

The checklist identifies a number of points during the assessment where various interim products are completed and interpretations and decisions are made. It is strongly recommended that the module leader ensure that all module team members are invited to participate at these critical points and that all products necessary to complete the interim review are available for review. The module team should recognize that once these checkpoints are passed and the team moves on, the team will not entertain additional discussion unless later stages of the assessment reveal uncertainties that the module team was not aware of. Team members and observers are strongly encouraged to bring forth questions and concerns at these checkpoints where the team can most effectively address them. Questions or concerns not brought forward in a timely fashion may undermine the effectiveness of the team's process.

The module leader should ensure that all the products are completed and contacts with other modules are established. The module leader will serve as the primary representative of those products and team discussions during the synthesis stages of the resource assessment.

Prescriptions

If resource sensitivities are identified in the resource assessment, there may be a need for technical expertise to advise the field managers team during the prescription phase of watershed analysis. The module leader serves as the primary contact to provide that expertise to the team as requested.

If you have been assigned responsibility for a resource assessment,

Go to the Pertinent Assessment Module and Perform the Assessment.

If you are not performing the assessment, but are interested in knowing the specific procedures and products of each module, you may want to read the Overview of Assessment Methods and Products section of each module which provides a brief summary of what is done in each module.